

Impacts of Invasive Species on the Environment:

Plants, Animals, and Microorganisms in Wildlands

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An invasive species is defined as a species that is

- 1) non-native (or alien) to the ecosystem under consideration *and*
- 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health. ([Executive Order 13112](#)).

Invasive species can be plants, animals, and other organisms (e.g., microbes). Human actions are the **primary** means of invasive species introductions.

Objectives

Impacts of invasions in rangelands, grasslands, shrublands, forests

Causes of invasion —Global change, land disturbance, development, fragmentation, absence of predators and parasites

Ecosystem Impacts of Invasive Plants

- Loss in productivity
- Lower biodiversity
- Reduced abundance of T & E species
- Increased erosion, fire, and flooding
- Increased water use, reduction in water table
- Changes in soil chemistry, e.g., salt accumulation
- Changes in soil microorganisms, e.g., reduced mycorrhizae with mustards
- Decreased aesthetic value, recreational opportunity
- ~230 plant species listed as current or potential problems (CA Invasive Plant Council)

Lost productivity--monocultures of
less palatable or less useful
exotic species replace native
species

Yellow star thistle

Centaurea solstitialis

12 million acres in CA

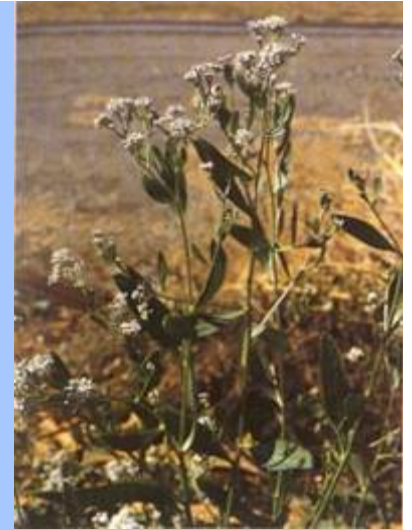


Cheatgrass, downy brome
Bromus tectorum
55 million acres in W. U.S.



Tall whitetop,
perennial pepperweed
(*Lepidium latifolium*)

> 2 million acres in western
U.S.



- Encroaching on rare plant populations at Suisun Marsh: soft bird's-beak (*Cordylanthus mollis*), Suisun Marsh thistle (*Cirsium hydrophilum*), Suisun Marsh aster (*Aster lentus*).
- Invaded marshes in the Alviso Slough area (May, 1995), and poses a threat to the habitat of the endangered salt marsh harvest mouse, California black rail, and California clapper rail.
- In waterfowl nesting areas competes with grasses that provide food for waterfowl.
- Aggressive invader of agricultural lands in the Central Valley and east of the Sierra Nevada. In Lassen County has become widely established in native hay meadows.

Perennial pepperweed replace native riparian vegetation, displaces animals dependent on native vegetation.



Roots do not stabilize riverbanks, cause erosion, poor water quality

Eiswerth et al. 2005 UNR-CE

Increased fire frequency
following exotic grass
invasion-- red brome fire at
Morongo Valley Preserve
Aug. 2005



Impacts on threatened and endangered species

Tamarisk, or salt cedar, and Willow fly catcher



Threadleaf Brodiaea and invasive annual grasses at Santa Rosa Plateau



Impacts on T & E species

(Gurevitch & Padilla 2004 TREE)

- Some species have become extinct by predation (e.g., Guam birds and brown tree snake).
- No plant species are known to have been driven to extinction by competition from invasive plant species YET
- BUT invasive plant species reduce the density of rare, T & E species. This means the probability of extinction increases following a catastrophic event, such as drought or large fire.
- Many managers of rare, T & E species have invasive control programs to assure that the species in their care do not succumb to competition from weeds.

Insects in Wildlands--Potential Impacts in California

- Fire ants--occasional in CA, \$billions in damage in SE, compete with native ants that are food for endangered horned lizard
- Asian long-horned beetle--individuals found in CA. Established in NE urban areas, kills many species of trees
- Cactus moth--endangering cacti in FL, projected to reach TX by 2007

www.invasivespeciesinfo.gov



Invasive animals

- Red fox--predator of clapper rails, snowy plovers, other
- Rats--prey on native birds, mammals, herps in wildlands
- Bull frogs--predator of native frogs, small mammals, birds
- Exotic stocked fish are predators of native fish, frogs



Wild boar, feral pig, *Sus scrofa*

Released for sport hunting in CA; ca. 130,000 pigs

Impacts

- a) Uproots plants, disturbs soil, causes erosion, alters habitat for other animals; also in residential areas
- b) feeds on acorns, green vegetation; prevents oak regeneration, competes with native herbivores
- c) predation: eats herps, bird nests, sea turtle nests; thought to be opportunistic, but recent evidence of active predation!

Dirk Van Vuren, UCD, pers. comm.

Disease organisms

- Sudden oak death *Phytophthora ramorum* has killed tens of thousands of oaks, tan oaks; occurs in many other plant species; economic impact on nurseries; loss of oak woodlands



Sycamore leaf scorch,
Pierce's disease, caused by
Xylella fastidiosa, an
indigenous bacteria (also
causes oleander leaf scorch
kills grapes, many plant hosts
unaffected)



Dispersed by invasive
glassy-winged sharpshooter
Homalodisca coagulata



www.invasive.org

Reduced aesthetic and recreational value

- Exotic plants reduce food, forage, and cover for birds and game species
- Riparian and aquatic invasive species block waterways

Invasive dune grass
Ammophila arenaria



Compare to diverse native
dune vegetation



Causes of Invasion

- Disturbance to land--grazing, agriculture, mining, urban development. Any disturbance that removes vegetation and disturbs soil will promote invasive species.
- Absence of predators and parasites that keep invasives under control in native habitat
- Land development--fragmentation, corridors
- Global change--elevated CO₂, climate change, nitrogen

Absence of predators, pathogens

- Predators, herbivores, and pathogens are usually left behind when species move to a new continent. This is why introducing biocontrols is effective.
- Examples: purple loosestrife, tamarisk, do not form monocultures in their native habitats, but have insect herbivores. Beetles, weevils have been introduced for control.
- Many pest insects are controlled by parasitic wasps, some of which have been successfully introduced for control (white fly, eucalyptus borer)

Land development--fragmentation, corridors

Roads, pipelines serve as corridors through undisturbed vegetation, enabling the spread of invasive species

Example: Sahara mustard along I 15 through Mojave Desert in spring 2005!

Native habitat is fragmented by agriculture, urban development, forest harvesting. Invasive species colonize fragments more rapidly.



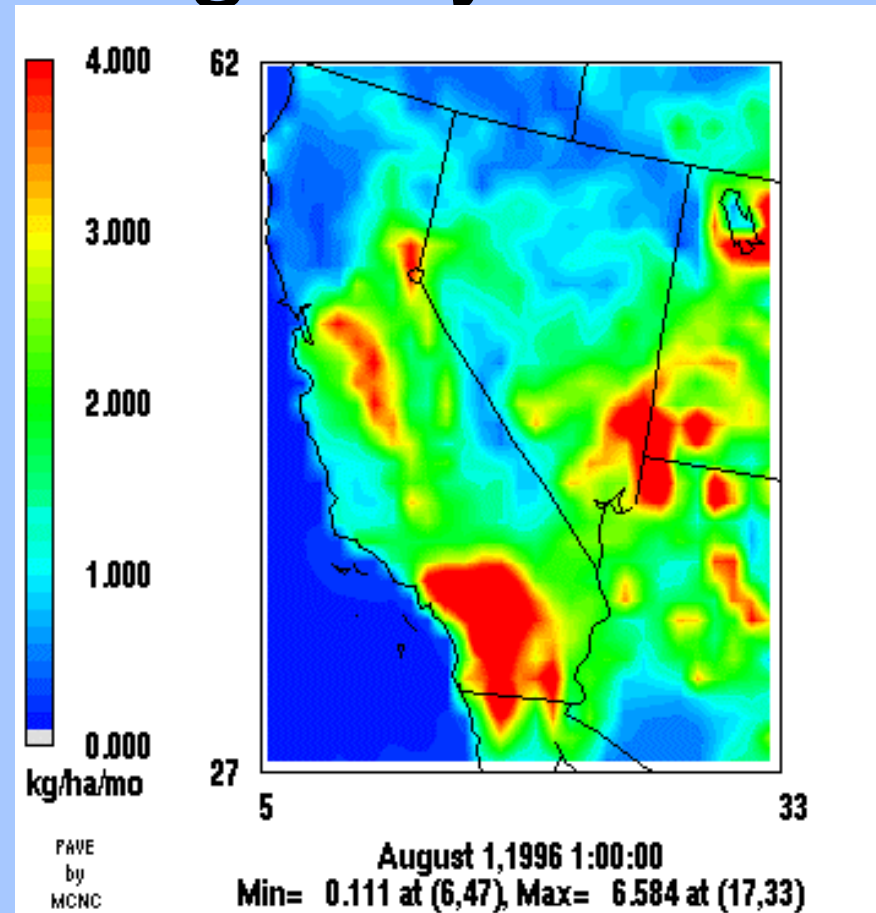
Global change

- Elevated CO_2 --Many weedy species have large responses to high CO_2 , e.g., red brome at Nevada Test Site under 550 ppm CO_2 .
- Ambient CO_2 is 370 ppm



Regional N Deposition max. 30 kg/ha/yr

Total N deposition,
 H/NO_3 , $\text{NH}_{3/4}$,
gaseous plus
particulate (Gail
Tonnesen et al.,
UCR)



Nitrogen deposition
in Riverside,
30 kg N/ha/yr



Nitrogen
deposition
near Joshua
Tree
National Park,
12 kg N/ha/yr



Box Springs Mt., Riverside, with high nitrogen deposition, high soil N, dominated by exotic annual grasses, high fire frequency, 10-30 native species/ha



Lake Skinner Reserve with low N deposition, low soil N, dominated by native forbs and shrubs, 70-80 native species/ha



Exotic grass (*Schismus*)
Invasion west of JOTR in
an area with high soil N,
High N deposition

Nitrogen fertilization at
Joshua Tree National
▪ Park to simulate
N deposition. Native
plant diversity and
abundance decreased.



Conclusions

- Invasive species are one factor that contribute to T & E status, may interact with other factors such as grazing, air pollution
- Invasive species will continue to expand under changing environmental conditions and increasing global trade
- Pre-emptive control prior to spread of suspected invasives, and control of existing invasives is necessary to reduce environmental impacts of invasive species

Rare Plants and Cover of Exotic Species

	<i>Cover of Exotics When Target Is:</i>		
<i>Species</i>	<i>Not present</i>	<i>Present</i>	<i>Status</i>
nevin's barberry	12.7	38.7	FE
coachella valley milkvetch	76.4	45.4	FE
triple-ribbed milkvetch	59.3	52.0	FE
mojave tarplant	33.3	59.7	SE
san jacinto valley crownscale	98.9	68.0	FE
thread-leaved brodiaea	110.9	129.1	FT

Insects of urban trees (biocontrol agents have been introduced in California)



Eucalyptus longhorned borer

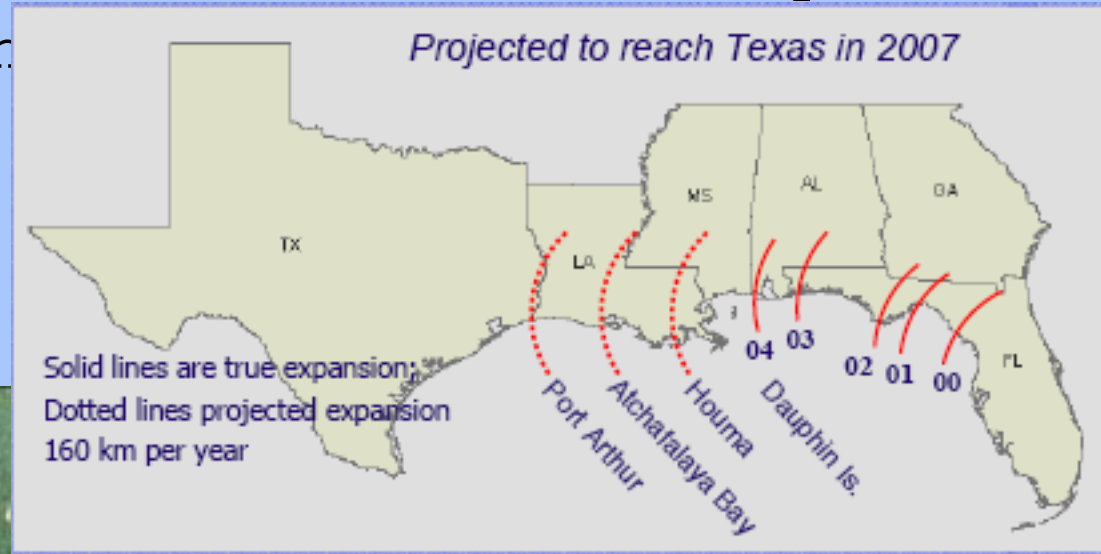


Ash whitefly



Cactus moth, prickly pear moth *Cactoblastis cactorum*

South American cactus moth introduced to Caribbean to control cactus, accidentally spread to Florida, n



Consequences
for California? High
diversity of plants in
the cactus family is
a concern.

www.invasivespeciesinfo.gov

Asian long-horned beetle

A few individuals found in California!

Currently an urban problem in NE US

Tree removal for control

Affects many tree species

May invade natural forests



Chicago neighborhood

